



# **Solar Energy and the Dynamics of Alberta's Electricity Market**

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# What does the Market Surveillance Administrator do?

- Investigation
- Enforcement
- Compliance with rules and reliability standards
- Market monitoring
- Guidelines
- Market assessments (State of the Market)



# Overview

- Market structure
- Spot market price available to solar generators
- Impact of solar on the hourly market
- Carbon externality
- Principles
- Accommodation of renewables
- Renewables are not unique
- Final thoughts

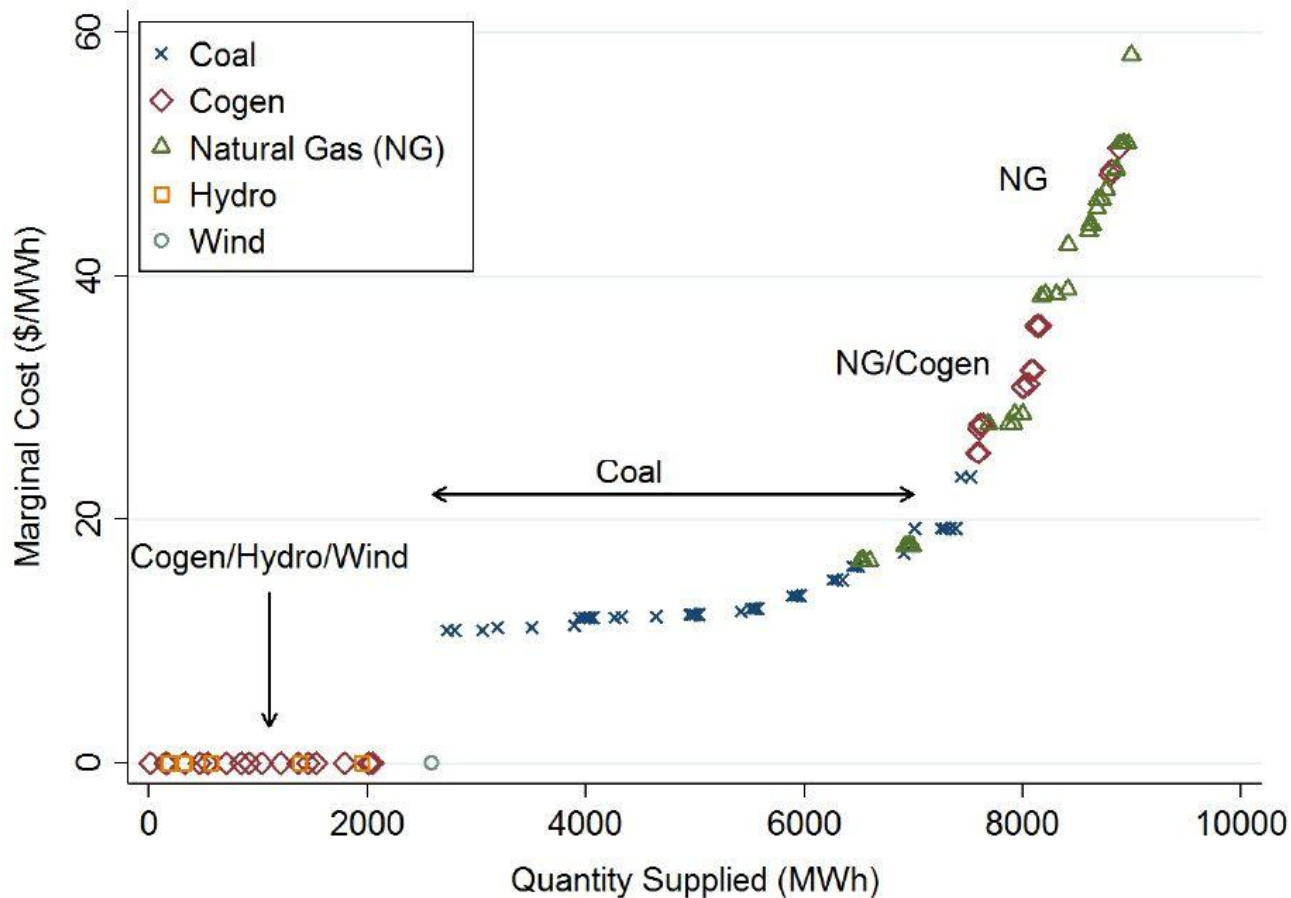


# Market structure

- “Energy-only”: generators paid hourly prices based on the energy and ancillary services they provide
- Hourly prices represent the economic value of electricity and reflect the competitive dynamics of the market; prices (value) can be volatile
- Forward markets exist but are small and relatively few long-term contracts are signed



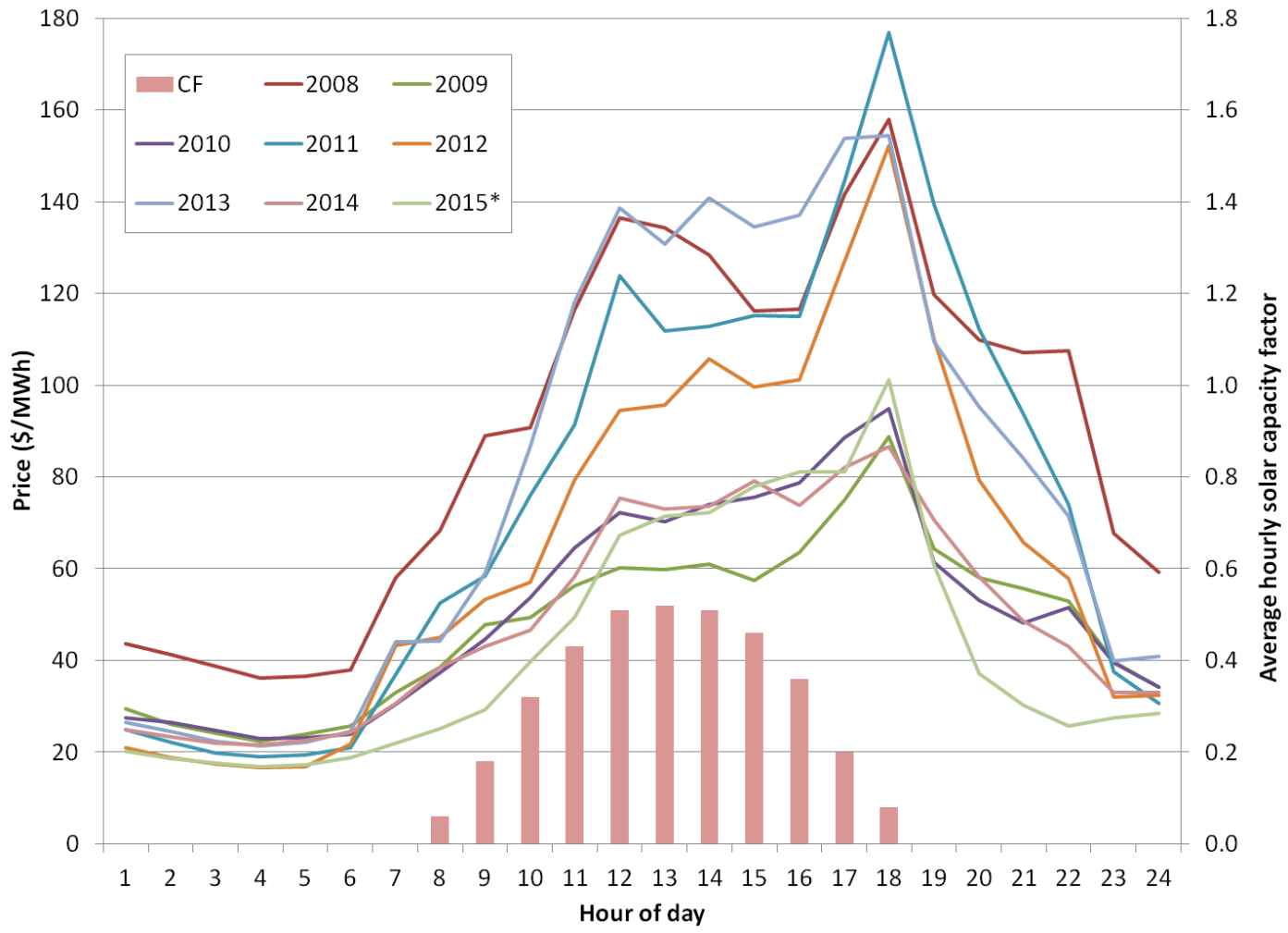
# Typical short-run marginal cost curve in Alberta



Note: A day in 2012. Source: Brown and Olmstead (2015).



# Spot market price available to solar generators



Year	Solar-weighted price
2008	\$ 121
2009	\$ 59
2010	\$ 70
2011	\$ 108
2012	\$ 93
2013	\$ 126
2014	\$ 69
2015*	\$ 66
Avg.	\$ 89



# Impact of solar energy in the market

- Like other generation, new capacity will increase the supply of energy when it is producing; eventually the spot price will decrease
- This feedback signals the market keeps supply in balance and prevents 'too much' entry
- Offsets use of incumbent capacity, lowering the available revenue; exit may occur
- Solar production is positively correlated with underlying demand



# Externality: Accounting for carbon emissions

- The cost of all other inputs to the production of electricity is signalled to the market through generator offers
- In the absence of policy the market would have no way to account for the carbon emissions externality
- There are numerous ways to provide this signal
  - Pros and cons
  - Trade-offs
  - MSA does not have a preferred option





# Are there any useful principles?

- From this economist's point-of-view:
  - Efficacy
  - Minimum emission abatement cost: intra- and inter-sectoral allocation of reductions
  - Efficiency: static and dynamic
  - Administrative cost and complexity
  - Confidence / credible commitment
  - Technological / size neutrality
- What about congestion and transmission?



# Accommodation of large scale renewable generation capacity

- Dispatchability by market mechanism (failure to consider this early in Ontario created problems)
- Enhanced forecasting
- Consideration of (non-exclusive):
  - Different price floors and caps
  - Day-ahead with real-time imbalance market (commitment, price volatility, market power)
  - Additional ancillary service products
  - Capacity market



# Renewables are not unique

- In important ways, renewables are not unique
- All of the approaches to the accommodation of large scale renewables on the last slide have been considered in the Alberta and other electricity markets for other reasons: dispatchability, forecastability, optimal price floors and caps, DA with imbalance markets, AS products, and capacity markets (list is non-exclusive)



# Further thoughts

- MIT's "Future of Solar Energy" project contains some exceptionally good analysis and discussion
  - e.g., significant focus on value of solar rather than just the cost



# Further thoughts

- New technology may allow load to become more
  - Price responsive
  - Supply-following
  - Flexible / shifting
- Zero emissions load balancing (California Council on Science and Technology)
- Electric vehicles (with large on-board batteries)
- AESO has been considering utility storage options
- Alberta has relatively large industrial load



# Contact information

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